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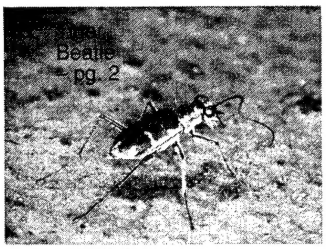

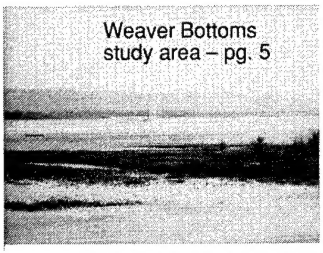

The *W*etlands *R*esearch *P*rogram

Bulletin

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Saltmarshes in eastern Nebraska: Study characterizes some unusual wetlands

by Michael C. Gilbert, U.S. Army Corps of Engineers, Omaha District, and
Randy G. Stutheit, Nebraska Game and Parks Commission

The city of Lincoln, Neb., was founded in the mid-1800s along Salt Creek. As the name of the creek implies, the potential for commercial salt production from saline wetlands played a key role in Lincoln's settlement and early history. Although other sources of salt that could be mined cheaply were found in the region, the impact of civilization on the Salt Creek wetlands continued.

During the last century, the saline marshes suffered extensive degradation through commercial and residential development, road construction, and agriculture. Today, Nebraska's eastern saline wetlands are considered to be among the most restricted and imperiled ecosystems.

Background about the wetlands

Hydrology. Eastern Nebraska saline wetlands are regionally unique, located in floodplain swales and depressions within the Salt Creek and Rock Creek watersheds in Lancaster and southern Saunders counties. Water regimes are temporarily and seasonally flooded on saline mineral soils. Water sources are a combination of discharge from the Dakota sandstone formation aquifer, precipitation, and overbank flooding. Salts are concentrated in the soil during dry periods.

Flora. Vegetation in these wetlands is characterized by halophytes including spearscale (*Atriplex subspicata*), inland saltgrass (*Distichlis spicata* var. *stricta*), saltwort (*Salicornia rubra*) (Fig. 1), prairie bulrush (*Scirpus maritimus* var. *paludosus*), sea blite (*Suaeda depressa*), and narrow-leaved cattail (*Typha angustifolia*). Four plant species considered rare in Nebraska are saltmarsh aster (*Aster subulatus* var. *ligulatus*), seaside heliotrope (*Heliotropium curassavicum*), saltwort, and Texas dropseed (*Sporobolus texanus*) can be found in the marshes along Salt Creek.

Figure 1. Inland Saltgrass and Saltwort at Hormone Marsh, an Eastern Nebraska saline wetland
(Photo courtesy of NEBRASKAland Magazine and Nebraska Game & Parks Commission)

Fauna. The saline wetlands provide habitat for a variety of wildlife species and serve as stopover for migratory birds, particularly for shorebirds during spring, when mudflats provide abundant invertebrate foods. These wetlands also are the sole habitat for an endemic tiger beetle, *Cicindela nevadica* var. *lincolniana* (Fig. 2).

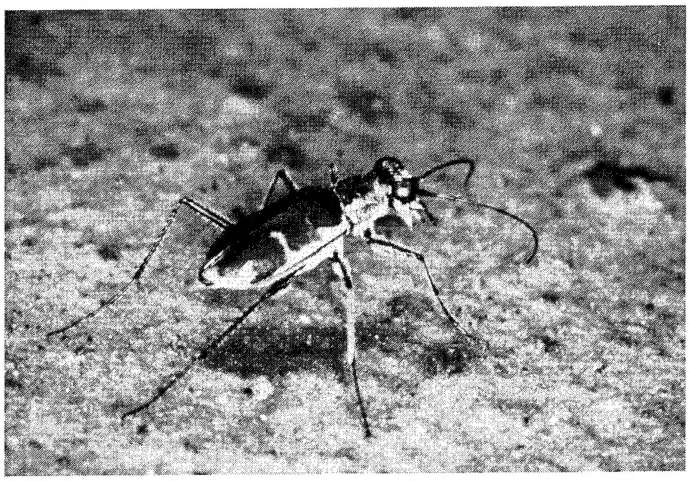


Figure 2. Tiger Beetle
(Photo courtesy of NEBRASKAland Magazine and Nebraska Game & Parks Commission)

Public awareness spawns characterization study

Since 1988, wetland inventory and public outreach efforts in Nebraska have contributed to an increased awareness of eastern Nebraska's saline wetlands and their importance. This awareness, and acknowledgement that a balanced, resource-based approach is needed for wetland survival, has stimulated public interest in preservation, resource-sensitive urban planning, cooperative wetland enhancement efforts, and mitigation banking. To ensure that information continues to contribute to the understanding of saline wetlands and to create opportunities for pro-active wetland initiatives, an updated inventory was compiled and technical value assessments of existing saline wetlands were conducted. An interagency team then designed objectives for a study to provide:

- the best information available about the location of saline wetlands in Lancaster and southern Saunders counties and
- a qualitative assessment of individual saline wetlands, their relative potential to maintain historic functions, and their value resulting from these functions.

The team of individuals from the Nebraska Game and Parks Commission, U.S. Army Corps of Engineers, Nebraska Department of Environmental Quality, U.S. Fish and Wildlife Service and U.S. Environmental Protection Agency identified study boundaries, established categorization criteria, and conducted individual site assessments.

Gathering mapping and site information

Distribution of saline hydric soils within the respective counties (Table 1) was used to establish study area boundaries. These data, in conjunction with existing Nebraska Game and Parks Commission wetland survey information, helped define the saline wetlands of interest (Fig. 3). The state wetland survey effort included both mapping products and information on critical species and plant community occurrences.

The study team was then able to prioritize site assessments for integration towards updated wetlands mapping. Digital National Wetlands Inventory data were the crucial link between field analyses and updating saline wetland inventory information. The combination of quality information prior to initiation of the resource categorization study, availability of new digital wetlands data, and field assessments focusing on critical habitat features provided the necessary components for study goals.

Evaluation criteria results in categories

Comparative site evaluations were based on the occurrence of the Salt Creek tiger beetle, presence of rare or restricted halophytes, historical significance, occurrence of halophytic associations, degree of degradation, degree of pollution, proximity to municipal or industrial solid waste

Table 1
Characteristics of Lancaster and Saunders Counties Saline Soils. Information Adapted from SCS Soil Surveys (Elder et al. 1965, Brown et al. 1980) and SCS Hydric Soils List (Soil Conservation Service 1988)

Soil Name	Map Symbol	Hydric-Soil Component	Slope	Salinity (mmhos/cm)	Depth to Water Table (ft.)
Lancaster County					
Lamo silty-clay loam	Lm	Salmo soil inclusions	0-2%	<2	2.0-3.0
Salmo silt loam	Sa	Seasonally high water table inclusions	0-2%	4-16	2.0-3.0
Salmo silty-clay loam (channeled)	Sb	Entire map unit	0-2%	4-16	0.0-2.5
Salmo silty-clay loam	Sc	Entire map unit	0-2%	4-16	0.0-2.5
Zoe silty-clay loam	Zc	Entire map unit	0-2%	2-8	1.0-3.0
Saunders County					
Rauville silty-clay loam	Ra	Entire map unit	0-2%	No Data	1.0-3.0

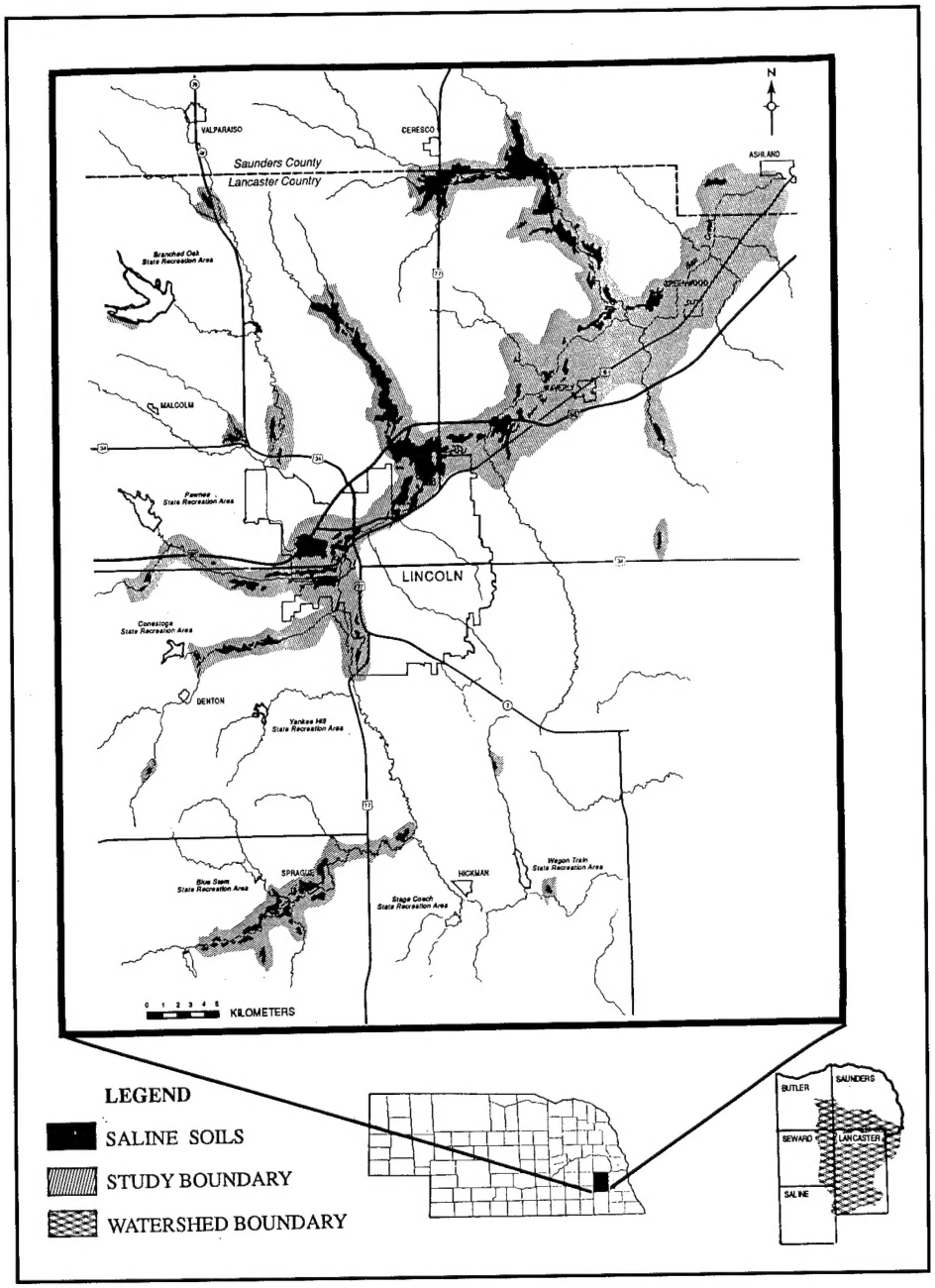


Figure 3. Study site location

disposal sites, and restoration potential. Scientists then defined four standardized wetland categories:

Category I: Site currently provides saline wetland functions of high value or has the potential to provide high values following restoration or enhancement measures. The site meets one or more of the following criteria:

- Salt Creek tiger beetle present,
- the presence of one or more rare or restricted halophytes
- identified as having historical significance by the Nebraska State Historical Society,
- contains at least one saline wetland plant association as part of the site's flora and is not highly degraded or has potential to maintain or improve saline wetland characteristics through enhancement or restoration,
- contains no saline wetland plant associations but high potential exists for restoring the historic salt source.

Category II: Given current land use and degree of degradation, site currently provides limited saline wetland functions and low values. Restoration potential is low. The site meets one or more of the following criteria:

- currently contaminated by hazardous or toxic waste or is/has been used for municipal or industrial solid waste disposal; has limited potential for providing high functions and values through restoration,
- contains at least one saline wetland plant association as part of the site's flora and is highly degraded; has limited potential for the long-term maintenance or improvement of saline vegetative characteristics through enhancement or restoration,
- contains no saline wetland plant associations and provides low functions and values due to degradation; has low potential for restoration of the historic salt source.

Category III: Site is functioning as a freshwater wetland having freshwater plant communities on a saline soil. Currently provides freshwater wetland values and no feasible restoration measures exist to reestablish the historic salt source and saline plant associations.

Category IV: Site is functioning as a freshwater wetland having freshwater plant communities on a non-saline hydric soil. Areas with insufficient data for categorization or inaccessible to the interagency work team were "NC" meaning "not categorized."

Categorization process described

The interagency work team identified some sites that had sufficient existing information on file for categorization

without a field visit. All other sites were visited by team representatives prior to categorization.

Site assessments were conducted during the growing season in 1992 and 1993. Standardized field assessment forms were used. In addition, a qualitative judgment by the interagency work team about the site's degree of disturbance or restorability was noted. Consensus among the interagency work team was required in the final determination of a category designation.

Results of category designations were summarized in a database. These data were then imported as a relational table for geographic information system-based mapping. Commercially available software for digital data processing and analyses was used.

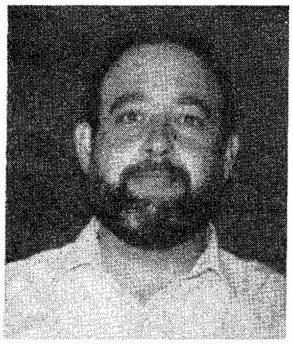
Results

Team members identified 276 wetlands with saline characteristics. More than 70 percent of these sites had sufficient data, either through documentation from the state survey or field evaluations, to allow category designations. In total, 5,644.1 acres of wetlands and deepwater habitats were identified within the study area.

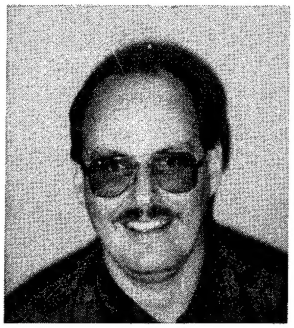
Category I wetlands were the largest both in terms of number of sites and acreage. None of the sites were of historical significance. Category I wetlands comprised approximately 57 percent of the total wetlands and deepwater habitats within the study area. Category II wetlands, with 7 percent representation, were the least frequent in terms of total acreage. Category III wetlands, freshwater vegetational communities on saline soils, ranked second in terms of acreage with 11 percent of the total wetlands and deepwater habitats. Category IV wetlands account for 10 percent of the total wetland acreage and deepwater habitats within the study area. No site data for Category IV wetlands were recorded, as these freshwater vegetational communities on non-saline soils were not a focus of the study. This category did, however, represent an important component of wetlands within the study area.

Seventy-nine sites were not categorized. All were located on saline soils. The status, quality, and halophytic character of these wetlands are presently unknown. Remaining non-saline wetlands and deepwater habitats within the study area are associated with rivers and lakes. Federal, state, and local agencies are currently using the study results in zoning applications, initiation of private mitigation banks, wetland acquisition, and day-to-day Section 404 permit reviews. The results of this study are available in computer mapping/database format. These data can be used in future applications for trend analysis, land use planning, and as a mechanism for prioritization of restoration sites. To maximize utility in these applications, digital data for land use classes, watershed units, and soils could be incorporated into future geographic information system analyses.

Additional information about the Nebraska eastern saline wetlands categorization project may be obtained by contacting Mike Gilbert at (402) 221-3057 or Randy Stutheit at (402) 471-5584.



Michael C. Gilbert is an environmental resources specialist with the Omaha District, U.S. Army Corps of Engineers. Gilbert holds a B.S. (1977) and M.A. (1980) in biology from the University of Nebraska at Omaha. He has worked 17 years in the regulatory program, responsible for regional studies including wetlands inventory, geographic information system applications, and major regulatory actions. He serves as the District's wetlands specialist for regulatory, natural resources management, and Superfund activities.

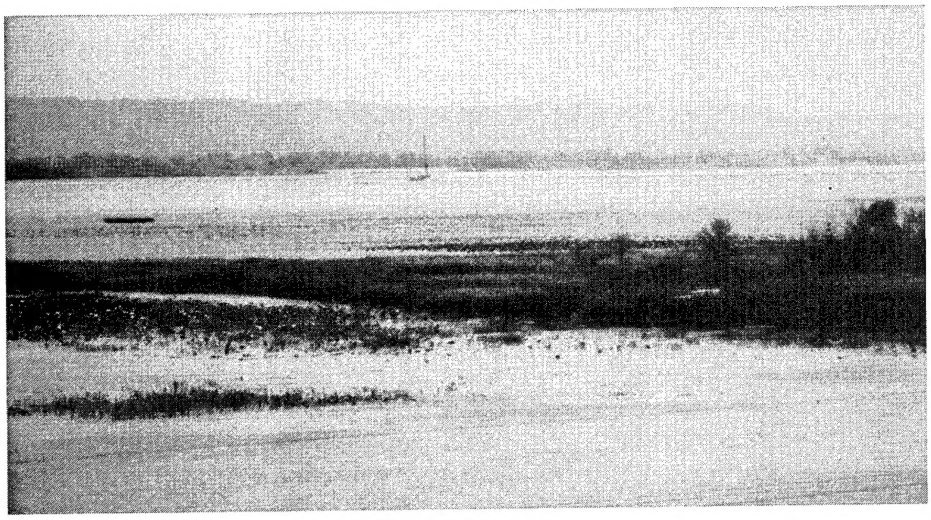


Randy Stutheit is a wildlife/wetland biologist with the Nebraska Game & Parks Commission where he has worked for 14 years. He received a B.S. degree in 1979 from the University of Nebraska—Lincoln, in natural resources, wildlife management. His wetland expertise lies in inventory and management of wetlands for migratory waterfowl and shorebirds. Stutheit's research interest is the use of wetlands by shorebirds during migration. Stutheit also participates in wetland creation/enhancement and waterfowl population studies.

Weaver Bottoms monitoring study: Determining the pros and cons of a rehabilitation project

by Dr. Mary Davis, U.S. Army Engineer Waterways Experiment Station

The banks and marshes of the Mississippi River have always provided healthy environments for many species of wildlife. In the early 1930s, the U.S. Army Corps of Engineers constructed a series of locks and dams in the Upper Mississippi River to improve navigation along the river from Cairo, Ill. to Minneapolis, Minn. Extensive areas of the floodplain were inundated and rapidly became highly productive backwater marshes. Since the early 1960s, however, acreage and vegetation density have fluctuated and gradually declined, lowering the quality of existing wetlands.



Panoramic view at Weaver Bottom study area

Project design

The Great River Environmental Action Team (GREAT) I was organized in 1973 to identify and assess problems associated with multipurpose use of the Upper Mississippi River and to develop recommendations for improved management of its resources. Weaver Bottoms, a 4,000-acre backwater area located between southeastern Minnesota and southwestern Wisconsin, was chosen as a representative site for a study of the marsh problems. An initial assessment of the site attributed the marshes inability to recover to a variety of reasons, including

- two major floods in the late 1960s,
- plant damage by wind and ice,
- the constant change in flow and sedimentation patterns, and
- reduced water clarity caused by wind-induced waves due to resuspension of sediments.

As a result, the Weaver Bottoms Rehabilitation Project was designed to do two things: (1) to reduce Mississippi River flows entering the backwater by modifying side channels, and (2) to reduce wind fetch and re-suspension of bottom sediments by creating barrier islands. In addition, the project was to reduce maintenance dredging requirements in the navigation channel and to provide long-term dredged material storage. The Weaver Bottoms project was to be completed in two phases. Phase I construction was completed during fall of 1986 and summer of 1987. Partial or complete closures were constructed across most of the secondary channels leading from the Mississippi River into Weaver Bottoms, and two 16-acre islands were constructed in open water areas. Phase II will be the construction of additional islands and/or implementation of other measures once the effects of Phase I construction are thoroughly evaluated and recommendations for Phase II can be made.

Planning and evaluation

An important part of the project was a comprehensive 10-year Resource Analysis Plan to monitor project effects. An interagency Memorandum of Understanding (1986), assigned leadership for the monitoring project to the U.S. Fish and Wildlife Service with active participation from the Corps and Wisconsin and Minnesota Departments of Natural Resources.

The Resource Analysis Plan called for an assessment of project impacts on hydrodynamics; sedimentation; water quality; emergent and aquatic vegetation; use of aquatic and wildlife habitats by birds, fish, and mammals; and recreational use. Monitoring began two years prior to project construction and continues. The first 5 years of the monitoring program resulted in the following:

- Hydrodynamics. Post-project monitoring indicated that secondary channel discharges to Weaver Bottoms were reduced 80 percent, and hydraulic residence time was increased to between 3 and 7.6 days. Current velocities within Weaver Bottoms have been reduced 60 to 90 percent. The two islands have altered flow patterns. However, hydrodynamic impacts of the islands on

Weaver Bottoms were small compared to the reduction in inflow due to closure of secondary channels. Wave action continues to be a major factor influencing bottom velocities and sediment resuspension.

Since project construction, the need for dredging has decreased dramatically (by 60 percent) in the Weaver Bottom area. This reduction was probably due to greater channel scouring caused by the increased river flows.

- Sedimentation. Bathymetry data from 1986 (pre-project) and 1991 (post-project) were compared with 1935 data. Construction of the project resulted in notable changes in erosion/deposition patterns in Weaver Bottoms. Although the net change in bathymetry from 1986 to 1991 was small, high rates of both deposition and erosion occurred. This fluctuation indicated that internal factors, such as wind generated wave action, have increased their influence on the sedimentation patterns in Weaver Bottoms.

  General patterns showed deposition in deep areas and erosion in shallow areas. Three areas in particular showed bathymetry changes since project construction: (1) One area with historically substantial erosion showed significant reduction of erosion since inundation; (2) the delta areas at side-channel openings along the main channel side of Weaver Bottoms showed both deposition and erosion; and (3) an area near the mouth of the Whitewater River showed increased rates of delta expansion as a function of reduced flow velocities into Weaver Bottoms following project construction.

- Water Quality. One project objective was to increase water clarity and thus improve vegetation growth. Water quality in Weaver Bottoms did not improve within the first 3 years following construction. Reduction of inflow from the Mississippi River also reduced mixing and flushing rates in Weaver Bottoms. Water quality in downstream portions of the backwater area became more influenced by the Whitewater River, a turbid river which empties directly into Weaver Bottoms. Variation in water quality values increased among areas within Weaver Bottoms after project construction as a result of differences in residence time.

- Vegetation. Between 1985 and 1990, a general decline in emergent and submergent aquatic vegetation was recorded in the Weaver Bottoms Rehabilitation Project area as well as in other areas of the Upper Mississippi River. The cause of the vegetation loss is unclear but is apparently related to the 1987 to 1989 drought and not due to project construction.

- Birds and Mammals. Aerial waterfowl transect surveys were conducted each fall from 1985 through 1990. Waterfowl use-days increased substantially between 1986 and 1987, but sustained a steady decline during the remaining post-construction period of 1988 to 1990. Annual diving duck (mostly canvasback, *Aythya valisineria*) use-days were more than double that of puddle ducks during the 1985 to 1987 period, but were below or nearly equal to puddle duck use-days for 1988-90. This post-construction decline in diving duck use probably reflected the drastic losses of American wildcelery (*Vallisneria americana*), a preferred canvasback food, in Weaver Bottoms during 1989 and 1990. Total use-days of another common migratory waterfowl in the area, tundra swan (*Cygnus columbianus)*, varied but were lowest in 1989 and 1990 when substantial declines in arrowhead (*Sagittaria spp.*) biomass were detected.

  Losses of vegetation and waterfowl use on the Weaver Bottoms project area were not attributable to the rehabilitation project, as evidenced by similar losses in nearby Upper Mississippi River pools. Changes in continental populations, habitat conditions, and weather also influenced migratory bird use of the river. The occurrence of muskrat *(Ondatra zibethica*), shorebirds, gulls, and terns at Weaver Bottoms was monitored, but no population trends were detected.

- Fish. Fish populations were monitored within and outside the Weaver Bottoms project area. Trap nets, experimental gill nets and electroshocking collection methods were used. Pre-construction sampling yielded 9,323 fish, representing 69 species with an average weight of 264 grams per fish. Post-construction sampling yielded 16,992 fish, representing 57 species with a higher average weight of 271 grams per fish. All sample methods showed an increase in catch per unit effort during the post-construction years. The proportion of sport fish, rough fish, and forage fish captured showed little change between pre- and post-construction periods.

  Four key species were identified at Weaver Bottoms: northern pike (*Esox lucius*), carp (*Cyprinus carpio*), bluegill (*Lepomis macrochirus*), and black crappie (*Pomoxis nigromaculatus*). Gill netting data shows a biomass increase for all four species in the post-construction period; carp increased the most. Similar increases in the four species at stations within and outside Weaver Bottoms indicates that population increases may be partially due to factors other than the rehabilitation project.

Short-term monitoring results.

Phase I of the Weaver Bottoms Rehabilitation Project had been constructed to improve habitat quality within Weaver Bottoms and to reduce maintenance requirements of the adjacent navigation channel. Results of the monitoring effort indicate that there has been little immediate

influence of the project on habitat quality for vegetation or wildlife in Weaver Bottoms or in adjacent areas of those studied. However, results indicate at least a short term reduction in channel maintenance requirements during the first 4-year period following Phase I construction.

More information about the project is available from Mary Davis at (601)634-2853, e-mail: mdavis@elmsg.wes.army.mil.

Dr. Mary Davis is a wetland ecologist in the Wetland Branch of the WES Environmental Laboratory. She received a B.S. degree in biology (1976), her M.S. in plant ecology (1985) and a Ph.D. in wetland ecology (1990) from Florida State University. Her primary research interest are wetland ecology and restoration. Davis is treasurer/secretary for the Southcentral Chapter of the Society of Wetland Scientists and a member of the Society of Ecological Restoration.

Professional meetings announced

NEPA Conference to be held at Fort Collins, Colorado

Colorado State University will host the *25th Anniversary Short Course on Advanced and Emerging Techniques for Improving NEPA Assessment*, Aug. 13-14, 1995. Six major technical sessions will be offered, with several papers of special interest to wetland scientists.

Registration information may be obtained by calling Colorado State Conference Services at (303) 515-7501.

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